

Special Seminar

Date: October 29, 2007

Time: 2:00 – 3:00 P.M.

Location: Bldg. 50 Auditorium

High Speed Semiconductor Detectors for Synchrotron Experiments at FLASH, LCLS and XFEL

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Presented by Lothar Strüder



One Silicon Drift Detector type detectors (SDDs, pnCCDs, CDDs and active pixel sensors (APS), DEPFETs) have been developed as high speed spectrometers for energies from 50 eV up to 30 keV in a single photon counting mode as well in an integration mode. They show high energy and high position resolution as well as high quantum efficiency for X-rays.

Their full well capacities exceed 10^7 electrons per pixel. The read noise close to room temperature is less than 10 electrons (rms) leading to Fano limited energy measurements at readout speeds of over 10^{10} pixels per second. Pixel sizes of $20 \times 20 \mu\text{m}^2$ have been realized on $500 \mu\text{m}$ thick fully depleted silicon as well as pixel sizes up to 1 cm^2 . Typical formats being experimentally evaluated are 256×256 or 1024×512 with pixel sizes from $35 \mu\text{m}$ to $75 \mu\text{m}$. The minimum sensitive detector thickness is $50 \mu\text{m}$, a maximum detector thickness is technologically limited to 1 mm, the maximum monolithic device size is $10 \times 10 \text{ cm}^2$.

Special designs have been proposed for synchrotron applications complying with the time structure (bunch structure) conditions of the recently approved XFEL to be built at DESY and the LCLS at SLAC. The X-ray imagers are based on the concepts active pixel detectors (DEPFETs) and fully depleted pnCCDs. They are dedicated for X-ray imaging from the kHz to the MHz range.

A detector system which satisfies the FLASH and LCLS specifications is presented on the basis of fully depleted pnCCDs with a format of 1024×1024 combined with a pixel size of $75 \mu\text{m}$ and a readout frame rate of 500 Hz. Subsystems are already operational and show the full agreement with the performance specified and required by the synchrotron light user. The presentation will include the discussion of the user requirements and specifications and measured properties of such a pnCCD system.

Measurements at the FLASH – XFEL and BESSY synchrotron will highlight the use of the detectors in real experiments.

If you have questions or need additional information please contact D. Mercedes @ x4974.